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THE MANUFACTURE OF ORGANIC CHEMICALS AT THE UNIVERSITY OF ILLINOIS

BEFORE the outbreak of the present war, a large percentage of all the organic chemicals used in this country, which included dyestuffs, developers and drugs, as well as the substances needed exclusively in scientific research, were imported from Europe. The largest part of these chemicals came from Germany and as soon as trade relations with that country were broken off shortly after the war began, it was necessary for the United States from that time to depend almost entirely upon the small stock on hand. An immediate growth in the chemical industry in this country took place and manufacturers were busy filling the demand, first, for the simpler substances as phenol, aniline and beta naphthol, then the more complex substances as hydroquinone, aspirin, salol, amidol, etc. Recently commercial concerns have been working, and are at present working, upon the more fancy chemicals, particularly among the dyestuffs and drugs. Until within the last six months, however, no attempt has been made to prepare either the complex organic chemical reagents needed in analytical work or substances used exclusively in scientific research. The supply of such chemicals in this country in 1914, held chiefly by large distributing houses and university laboratories, was considerable so that by careful conservation on the part of the universities and greatly advanced prices on the part of the distributing houses, a serious lack of these compounds was not felt until this last year. Nevertheless, for the past two winters it has become necessary in universities where large amounts of organic chemical research have been carried on, for a student to spend a considerable part of his time which under normal conditions would be devoted to original investigation, in preparing various

substances which previously he had been able to purchase. The manufacturers have had good reason for not undertaking the production of such substances, because the number of chemicals of considerable commercial value not yet manufactured in this country is still large and it has been impossible for the various concerns to obtain even a sufficient number of chemists for this work. Moreover, the demand for organic chemicals used exclusively for research work or the demand for organic chemical reagents in the United States is small and the methods of preparation often difficult so that no profit could be expected from such a branch of the industry. In fact, a firm would be fortunate not to incur a considerable loss in such an undertaking, provided their selling prices were reasonable.

A number of the university laboratories, in order to overcome the trouble which thus arose, made during the summer months certain chemicals necessary for the winter researches. At the University of Illinois especially, this manufacturing was taken up extensively. It was started in the summers of both 1915 and 1916, a few graduate students working out the processes for, and then preparing, a few kilos of some ten or fifteen substances. Since this plan worked out successfully, it seemed worth while to develop the work further and also to give other institutions, where organic research was being done, the benefit of the experience gained in the Illinois laboratories. Consequently, last spring a letter referring to the manufacturing and the possibility of expanding the work to fill the demand of other laboratories was sent to the departments of chemistry of over twenty of the leading institutions of the country, as well as to the larger distributing houses that might be interested. Favorable replies came in and several orders for chemicals were received in spite of the fact that at that time no quotations could be given. About ten students were retained for the work during last summer and the manufacturing was carried on from the first of June until the first of September. Shortly after the work had been started, the news of it spread and more and more requests came until nearly eighty different chemicals were prepared in amounts ranging from a few grams to over sixty pounds. A business which during the summer it was expected would be about $1,000 turned out in the neighborhood of $5,000 and the only reason it was not larger was on account of the lack of men and laboratory facilities. Especial attention was paid to the development of methods from the laboratory scale to amounts of from one to two pounds and to the elimination of expensive and needless processes which are, almost without exception, used in the teaching of elementary organic chemistry. This kind of work is of first importance to the chemical industry at present so that in addition to the advantage of saving much time for the students during the winter, special training such as they could hardly receive in any other way in a university was given to these men. Moreover, the men were paid 25 cents to 35 cents an hour, a sum sufficient to cover their living expenses.

The whole undertaking proved to be very satisfactory and great help was given all over the country. More than thirty university laboratories, many technical concerns, and many of the large distributing houses were supplied. Because of the success of the plan, arrangements were made when the university opened last fall to continue the manufacturing. Two men were given so-called manufacturing scholarships and were to devote all their time to this work for one semester, with the exception of a few hours each week spent at lectures. Several other men were hired by the hour from time to time to attempt to keep up with the orders. It has been decided to continue the work and if possible to increase the staff to four or five men doing full-time work. Since last summer, demands for chemicals have continued to come so rapidly that only a small fraction of the compounds wanted could be furnished. The number of different chemicals already sold outside of this laboratory has increased to over one hundred twenty and the value of the manufactured substances now amounts to between $8,000 and $9,000. When one considers that for the most part

the chemicals have been distributed in lots of a few grams to a few ounces, in some cases in amounts of a few pounds, it is easy to realize the labor involved in this work. Although the above figures in dollars may seem insignificant compared with those of an ordinary commercial concern they seem large for this type of manufacturing when one is reminded that very little apparatus, a few copper cans and two or three large stoneware jars, was purchased outside of the equipment already available; that the amount of each chemical manufactured at one time was generally one to two pounds, sometimes less, and never over five pounds; and that the work is being done by comparatively inexperienced men.

Many different types of chemicals have been synthesized. Of those badly needed in analytical work may be mentioned dimethyl glyoxime, nitroso beta naphthol, cupferron, nitron, ninhydrin. Dimethyl glyoxime, before it was ready for sale by the University of Illinois, was entirely off the market. This reagent is most valuable for the quantitative determination of nickel and without it nickel steel manufacturers and analytical laboratories had to use less satisfactory methods in their nickel analyses. Although only extremely small amounts of this substance are needed for a determination, over 60 pounds were sold within the first month. Nitroso beta naphthol is a reagent for the quantitative separation of cobalt and nickel, nitron for the quantitative determination of nitric acid and nitrates, cupferron for the quantitative separation of copper and iron, and ninhydrin is used as a delicate testing reagent for alpha amino acids. The demand for these has been comparatively small but, nevertheless, urgent. Other chemicals widely used in synthetic organic chemistry have been made, such as malonic ester, acetoacetic ester, ortho and para nitro benzoic acids, dimethylamine hydrochloride, allyl alcohol and acetonitrile. In one or two instances, chemicals as amyl alcohol and amyl acetate of a very high degree of purity have been prepared for certain biological laboratories, or again, as ethyl benzene, for certain physico-chemical work. Various rarer chemicals to be studied for their insecticidal action as furfural and chloropicrin, others for their various physiological properties as tetranitromethane or mercury dimethyl have been synthesized and finally many uncommon chemicals needed purely for scientific research. Especial attention has been given to the purity of all the chemicals sold. They have been carefully tested and in many cases have been compared with samples of Kahlbaum's products which had been obtained before the war. Wherever this was done, it was found that those manufactured at Illinois were certainly as good and in many cases much better than the imported materials.

In general, the chemicals have been sold at a price which would cover labor, raw materials, and a general overhead charge and when sold to commercial concerns, a slight profit was added. Whenever chemicals were made which in ordinary times had been manufactured on a large scale, for the most part in Germany, it was generally impossible to make them at a price approaching that which existed before the war. If, however, the chemicals were those which had never been manufactured on a large scale, it was found that even though the raw materials were much more expensive than previous to 1914, in practically every case the cost was either below, or never much above the 1914 Kahlbaum price. If only a few grams of a substance were made, it was natural that the charge had to be high if expenses were to be covered. Thus whenever it seemed probable that there might be a future demand for these substances, a larger amount was synthesized and kept in stock, thus lowering the price and possibly being of aid to other laboratories at a later time.

Recently a committee has been appointed by the President of the American Chemical Society consisting of five organic chemists, one from each of five of the leading institutions in the country, Johns Hopkins, Chicago, Michigan, Columbia and Illinois. The purpose of this committee is to arrange for cooperation in this work among the scientific schools, hoping thus to cover much more ground than one university possibly could.

Innumerable difficulties are involved with such a plan but it is hoped it may be successful.

Within the last few months, two small commercial concerns have started developing this same branch of the industry. They have confined themselves as yet to preparing the more important reagents for which there is constant demand and to manufacturing the bacteriological stains needed so badly in physiological work. The prices charged by these firms are necessarily high, in fact so high that they are almost prohibitive to most of the university laboratories. These prices in the course of time will undoubtedly be lowered and the universities can then devote their energies exclusively to compounds required only for scientific research. It may be possible in the near future to have cooperation between these firms and the university laboratories, an arrangement which would be an advantage to all concerned.

Whether such small companies can live after the war and expand and so supply the demand for rare chemicals in this country is a question. It seems improbable that they will be able to compete with the foreign supplies unless a high tariff is levied. It is hoped however that the present work of these concerns may continue not only until the war stops but until such a time as a large chemical manufacturer as the National Aniline & Chemical Co. or the DuPont Co. will be in a position to undertake this branch of the industry in a thorough way and enter the business, not for profit but to be of real service to the country and to make the United States independent of foreign laboratories in this as well as other chemical lines. It is the present intention, at any rate, at the University of Illinois, to continue the work permanently, so that regardless of the great help that can be given outside, there may be a university where a graduate student in organic chemistry may be drilled in commercial methods before he goes permanently into technical work.

Roger Adams

University of Illinois

SHALL WE EAT WHOLE-WHEAT BREAD?[1]

The shortage of wheat and wheat flour, due to the excessive demands of the allied armies and neutral nations, has forced Federal and State Food Administrations to adopt certain policies in regard to the consumption of these very important foodstuffs. For example, steps have been taken to control the distribution of flour in a manner similar to that applied in the retail distribution of cane sugar. An educational campaign has been inaugurated with the view of educating the people to the consumption of larger quantities of the other cereals such as oatmeal, barley, rye and corn in substitution for wheat products. Another suggestion, which has met with some opposition, is that of milling a larger proportion of the wheat berry into flour, making what is usually termed a whole-wheat flour. The advocates of this idea argued that by milling a larger portion of the wheat kernel into the flour there would be less bran, shorts and middlings to be sold for stock feeds, wheat would go farther as a human food, and the amount saved would be available to assist in meeting the increased demand for wheat. The scientists and administrators supporting this view also contended that whole-wheat flour contained certain nutrients that standard patent flour did not contain and therefore was a better food and on account of the content of bran or "roughage" in the former it possessed a distinct advantage over the standard patent flour on account of its laxative action.

A counter campaign of education was immediately launched by certain of the milling interests represented by Professor Harry Snyder, formerly of the University of Minnesota. Professor Snyder has maintained throughout, both in public speech and in published articles, that "white bread is the best war bread" on account of the fact that it is more nutritious than the breads made from 82 per cent. extraction flour or flour milled from the entire

[1] Address before the University of Minnesota Section of the American Chemical Society, November 23, 1917.

grain (graham flour). Professor Snyder has gone a step further and makes the assertion that whole-wheat flour is not only less nutritious but is actually harmful, causing diarrhea and digestive disturbances. In this connection the statement is also made that the dairy industry can not be deprived of mill by-products which make up a very important part of the ration of the dairy cow.

There is little wonder that the consumer is at a loss to know what course to follow in his endeavor to do all in his power to cooperate with the government in the conservation of wheat.

It is not the object of this article to show that standard patent flour should not be milled; neither is it necessary to advocate that all of the wheat kernel should be milled into flour. The writer does contend that the attack on the higher extraction flours is unmerited, especially in view of the present situation; that whole-wheat flour is more valuable as a food material than the milling interests would lead us to believe; that whole-wheat flour when eaten with a balanced meal does not normally cause digestive disturbances, and that these views are held by many of the foremost authorities of food and nutrition in this and other countries. It might also be added that more economical feeds are available or can be made available for the dairy and animal industries.

It is to be expected that the milling interests would take the stand described above, for the people have been educated to believe that light, fluffy, white bread was the best bread for human consumption, and the milling interests have become organized both in personnel and machinery to give the people what they want regardless of its advisability. In order that the mill by-products should not represent financial loss, another artificial condition has developed in the live-stock and dairy industry. That they might dispose of the offal of the grain remaining after the manufacture of the white flour, the milling interests have encouraged the farmer to feed mill by-products, such as bran, shorts and middlings, until he has ceased to think of producing concentrated feeding materials and has become a victim of the mill-feed habit. Mill feeds have advanced in price with the result that dairy products have also increased in cost. The farmer is taught that he must feed wheat bran to procure the best results and at the present time bran is selling on the market at the exhorbitant price of $42.00 a ton and higher. If the farmer would only realize that he could produce as much milk at less cost by growing more corn and ensilage feeds; by growing more of those very valuable protein-bearing plants, clover and alfalfa, he would never again resort to the expensive mill feeds. In addition to obtaining valuable food materials cheaper, he would be increasing the value of his land by growing these legume crops, for they build up the nitrogen content of the soil and thereby assist in establishing a more permanent system of agriculture. In addition to their high content of protein, the legumes are very valuable on account of the large quantities of other nutrients; carbohydrates are relatively high and what is of great value to the dairy cow especially is the relatively large amount of calcium in these plants. Milk always contains a large proportion of this element and when the animal does not get a sufficient quantity in the feed (this is true with mill products) she is forced to take it from her tissues, *i. e.*, her bones. This happens when she is receiving fairly large quantities of calcium in her ration.

Taking up the question of wheat as a human food, we must realize at the outset that "man can not live by bread alone." This has been proven by scientific experiment. Wheat does not contain the right quantities of nitrogenous substances; its mineral content is far from ideal and the Wisconsin Experiment Station has shown that animals fed on a diet restricted to the wheat plant (cereal and straw) did not develop in a normal manner.

Normally, 100 pounds of wheat yield about 73 pounds of standard patent flour. Compared with whole-wheat flour patent flour is somewhat lower in protein but slightly higher in carbohydrates. When whole-wheat or graham flours are burned in a calorimeter so

that the heat can be measured, Professor Snyder has found that the higher extraction flours are equal to or exceed the patent flours in heat value. In one of his publications[1] in 1897 Professor Snyder states "omitting details of the separate experiments it was found that there was practically no difference in the total digestibility of breads made from the three kinds of flour (patent, baker's and whole-wheat flours)." And in proof of his argument Professor Snyder submits the following data:

TABLE XXVII

Digestibility of Bread

	Bread from Patent Flour. Per Cent. Digested	Bread from Bakers' Flour. Per Cent. Digested	Bread from Whole Wheat Flour. Per Cent. Digested
Dry matter.....	94	93	93
Protein.....	86	84	87
Fat.....	87	87	86
Carbohydrates....	97	97	97

These figures would lead us to believe that his conclusions are correct and we might even go further and say that the digestibility of protein was in favor of the whole-wheat flour. The protein in the whole-wheat flour was 12.81 per cent. and in the patent flour 12.44 per cent. This was in 1897. In 1901 Professor Snyder published the results of another set of experiments using other wheats and other men in the digestion trials and concluded that "while there actually may be more protein in a given amount of graham or entire-wheat flour than in the same weight of patent flour from the same wheat, the body obtains less of the protein and energy from the coarse flour than it did from the fine, because, although the including bran and germ increases the percentage of protein, it decreases the digestibility." Granting that Professor Snyder is right in either of his conclusions, we can rest assured that the difference in digestibility of the two flours is not great.

Professor Snyder states that 106 pounds of whole-wheat flour are required to be equal in nutritive value to 100 pounds of patent flour and it is upon this peg that all of the miller's arguments are hung.

[1] Bulletin 54, Minnesota Experiment Station.

Let us assume that 100 pounds of wheat are milled, yielding 73 pounds of patent flour and 100 pounds of the same wheat are milled to 82 pounds of whole-wheat flour and another 100 pounds are milled to practically 100 pounds of graham flour. Using Professor Snyder's own digestion coefficients,[2] we find that the energy available in patent whole-wheat and (graham breads were 90.9, 89.8 and 85.1 respectively. If we should feed 100 pounds of the same wheat in the form of patent flour (73 per cent. extraction), whole-wheat (82 per-cent. extraction) and graham flour, we would find that out of 182.64 large calories of heat in 100 pounds of wheat, man would actually be able to utilize for growth and development 115.64 large calories in the patent flour, 127.91 large calories in the whole-wheat flour, and 153.19 calories in the graham flour, showing a loss of 25 per cent. of available energy when patent flour is used. When the protein is compared, we find that Professor Snyder's figures show that out of 100 pounds of wheat we actually receive into the blood for tissue building purposes the following amounts of protein: patent flour, 8.75 pounds, whole-wheat flour, 9.68 pounds, and in graham flour 11.76 pounds of protein, showing a loss in patent flour of 25 per cent. of available protein.

Calculation also shows that if we feed bran, shorts or middlings to farm animals and then eat the meat, we lose from 60 to 80 per cent. of the available nutrients, which would indicate that it is more economical to utilize the greatest amount of the wheat kernel as human food and manufacture animal tissue on cheaper feeds.

The argument will be advanced that whole wheat flour costs nearly as much as patent flour and therefore the former figures are not applicable to present conditions. The present conditions are merely artificial—as soon as the people demand more of the whole-grain flours (which are milled at a lower cost than patent flour) just that soon will the price of the whole-grain flours begin to drop.

It is entirely feasible to mill higher ex-

[2] Snyder, 1903, U. S. Dept. Agr. Office Exp. Sta. Bull. 126.

traction flours at a lower cost than the present one. Millers argue that whole-wheat and graham flours do not keep in storage as long as patent flours. At the present time, this is not a question demanding consideration, for the flours are utilized within a few weeks of the time they are milled.

I do not wish to be interpreted as advocating the milling of flour containing the entire wheat kernel, but I feel that at the present time the higher extraction flours could be used to advantage.

From the standpoint of mineral nutrition, the higher extraction flours are more valuable as they contain a greater proportion of the mineral matter than the patent flours. The vitamines or growth-promoting substances of the wheat kernel are stored largely in the germ and are lost in the bran when patent flours are made. From this standpoint the higher extraction flours are more valuable.

It is an accepted fact that a large proportion of people are troubled with constipation; the higher extraction flours are valuable to correct this. In this connection we are told that the Belgian people were ordered by Mr. Herbert Hoover to make bread containing more white flour because of the digestive troubles experienced by the people on the whole-grain bread diet. Mr. W. C. Edgar, editor of the *Northwestern Miller,* states in one of his editorials that he was responsible for this order, having observed the digestive troubles experienced by the people. Mr. Hoover acted upon Mr. Edgar's suggestion. Dr. A. E. Taylor, physiological chemist at the University of Pennsylvania, went over the same ground and concluded that the people were suffering from malnutrition due to a one-sided diet, largely bread. He believes the digestive troubles to be secondary, due to broken-down constitutions and inability of the people to ward off disease. The latter conclusion seems the most logical, for the experience of the American people has been in direct opposition to the former idea, especially when eating well-balanced diets containing whole-wheat breads. In fact, we find the papers and magazines carrying advertisements of the larger milling companies advising us to eat bran in lieu of a ten-mile walk and become healthy. If we can eat wheat in the form of bran muffins and white bread, why not eat whole-wheat breads occasionally and save the miller the trouble and expense of separating them for us?

Regarding the nutritive value of the whole grain compared to the patent flours, practically all of our authorities in nutrition are agreed that the higher extraction flours are best. A government chemist of prominence wrote to 45 nutrition experts in the United States asking several questions, among which were the following:

1. "From your experience, is white bread a contributory cause of constipation?" The percentage of experts answering in the affirmative were 48.5, answering "no" 32.5 per cent., and the remainder were in doubt.

2. "Can whole-wheat or graham bread be considered helpful in constipation?" Here the affirmative answers represented 86.5 per cent. of the total number.

3. "Can long continued use of the whole-wheat or graham bread produce injurious results?" Seventy-five per cent. answered "no" to this question, while 5.8 per cent. of the writers were of the opinion that harmful effects could be expected. The others were in doubt.

4. "From the single standpoint of nutrition, which is preferable for general consumption by the people of the United States, white, whole-wheat or graham bread?" 65 per cent. expressed themselves in favor of whole wheat or graham, 10.8 per cent. being in favor of white bread and 16.2 per cent. had no preference.

5. "From the single standpoint of the laxative effect, which is preferable for general consumption by the people of the United States, white, whole-wheat or graham bread?" Here 86.5 per cent. of the authorities were in favor of the higher extraction flours.

6. "Considered both from the standpoint of nutrition and the standpoint of laxative effect, which is preferable for general consumption by the people of the United States, white, whole-wheat or graham bread?" Here

again the higher extraction flours received the approbation of 78.5 per cent.

7. "From your experience, which is the best flour, white, whole-wheat or graham?" Only 8 per cent. were in favor of the white flour, while 65 per cent. expressed a preference for the other flours.

Dr. Louis Lapicque, a nutrition chemist for the French government, stated recently[3] that his experiments led him to conclude that 85 per cent. extraction is necessary in France and that "for every five parts which are added when the yield is increased from 80 to 85, four of these are available."

When the layman is debating as to the best policy to formulate in stocking the family larder, he should keep in mind that the higher extraction flours are (1) not normally harmful, (2) are digested almost as completely as the lower extraction flours, (3) contain more valuable nutrients in the form of "vitamines" or growth-promoting substances, and mineral salts, (4) can be manufactured more cheaply when the public demands more of the whole wheat flour, (5) that the laxative action is beneficial, (6) and what is more important at the present time, more grain will be released for the allied armies, and (7) that these conclusions are supported by the majority of nutrition authorities.

If it is true that food will win the war, it is certainly a patriotic duty to save and conserve our wheat. One method is to include as a part of our daily diet food products made from higher extraction flours.

R. A. Dutcher

University of Minnesota

SCIENTIFIC EVENTS

THE OUTLOOK IN FRENCH AGRICULTURE

The *Revue Scientifique* for September 22 contains a report on the position and prospects of French agriculture presented by M. Louis Mangin, of the Académie des Sciences, to the National Council of the Ligue Française on behalf of the Committee on Economic Organization of that body. According to an abstract in *Nature* wheat production has fallen to barely 70 per cent. of the pre-war crop, potatoes to 80 per cent., wine to 65 per cent. and sugar-beet to little more than 30 per cent. The situation as regards live stock shows the same disquieting features. Practically 20 per cent. of the pre-war head of cattle fell into the hands of the enemy, and ill-devised measures taken to secure the meat supply in the early days of the war further seriously accentuated the shrinkage. Although the cattle position from the point of view of numbers has since been substantially improved, the proportion of young stock is so great that substantial relief of the meat stringency can not be expected from home resources for a considerable time. The decline in numbers of sheep which had set in long before the war has been greatly accentuated. Pigs also show a decline of 38 per cent. since the end of 1913. No reference is made to the position as regards milk production. A survey of the forest area completes the tale of depleted resources, something like one eighth of this area having been already denuded, with but little provision for its replacement.

Many suggestions are put forward for the relief of the present situation and for the future restoration and strengthening of French agriculture. The claims of rice as a diluent of wheaten flour are strongly urged in view of the large supplies available in the Asiatic colonies. To overcome the difficulties of shortage of manual labor on the land, the organization of supplies of African and yellow labor is suggested, whilst further relief could be obtained by a more active policy with reference to the production and use of motor tractors and farm machinery in general. The example of England in placing this manufacture under the same control as that of munitions of war is warmly commended. Consolidation of estates is urgently necessary and should be accompanied by a revision of the register of lands. The price of corn should be left sufficiently free to rise to encourage production, whilst at the same time the rise in the price of bread should be restricted by all appropriate means. It is suggested that these two ap-

[3] *Comptes Rendus de l'Acadamie de Sciences*, Vol. 165, p. 143.

parently irreconcilable objects can be effectively attained through the establishment of municipal bread bureaus, which should subsidize or tax the bakers according to the fluctuations in the price of corn. This expedient was successfully resorted to during the Crimean War.

It is urged that the home production of manures should be fostered by using every measure to increase the output of sulphate of ammonia, by developing the synthetic manufacture of nitrates and ammonia from the atmosphere, and by increasing the production of superphosphate, all of which industries, it is urged, should have the same privileges as munition factories. To secure increased crops arrangements should be made for free distribution of manures to small cultivators.

Measures must be taken for restoring the head of live stock. To this end restrictions must be placed upon slaughter of home stock; the colonial resources of Madagascar and Africa must be drawn upon for meat, to be prepared there in frozen or otherwise preserved condition in order to reduce costs of transport. For the same reason abattoirs and refrigerating plants should be established in the home meat-producing districts, whereby cheaper production and reduction in the number of middlemen would be secured. The strong prejudice of the people against refrigerated or preserved meat must be broken down, and much could be done in this direction by the use of such products throughout the Army and Navy.

THE SHALER MEMORIAL EXPEDITION

AFTER the death of Professor Nathaniel Southgate Shaler a group of more than 700 Harvard alumni raised an endowment for the "Shaler Memorial Fund," the income of which was to be used for geological research. The *Harvard Alumni Journal* reports that carrying out of the purpose for which that fund was created, a Shaler Memorial Expedition was organized last year to cover much the same ground which Professor Shaler himself traversed in a journey during the summer of 1873. The expedition of 1917 set out to study the stratigraphy of the Ordovician formations from Pennsylvania to Alabama; were Professor Shaler alive, he would be especially interested in the attempt to correlate formations over so large an area, or, as he expressed it, the study of "that wonderful record of the first stages of the life and sea."

Professor J. B. Woodworth conducted the first Shaler Memorial Expedition; it went to Brazil in 1908. The expedition of 1917 to the Appalachians was conducted by Dr. Percy E. Raymond, associate professor of paleontology and curator of invertebrate paleontology at Harvard University, who started from Cambridge on August 1. He was joined at Salem, Va., by Mr. Richard M. Field, lecturer at Brown University. Thence the party worked southward as far as Bristol, Tenn. Dr. Ellis W. Shuler, of the Southern Methodist University, Texas, acted as guide from Blacksburg to Bristol.

As in Professor Shaler's expedition of 1873, the travelers of 1917 had to be "free to move in any direction." Even with the greatly improved railroad facilities, it was next to impossible, without independent means of transportation, to cross and recross the mountains along their entire length, in the time allowed. The Appalachians still remain a great barrier to the interior of our country, a fact of considerable military significance. But the automobile solved the problem of transportation, as the wagon did in 1873; although tire and engine troubled occurred, the car was a great aid in reaching distant and out-of-the-way sections, and bringing in specimens.

During the first field-season the party was able to work the principal sections between Pennsylvania and Tennessee, and it is hoped that two additional years of intensive study, especially the northward, will supply the material for a thorough description of the Ordovician rocks and faunas of the Appalachians.

The first year's work has already brought to light facts regarding the nature and distribution of sediments and faunas which are original and contrary to some preconceived ideas. The field work in Central Pennsylvania, which was started independently in 1915 by

Mr. Richard M. Field, has been completed, and the results will soon be ready for publication. The outstanding features of that section are certain peculiarities of the fauna which have been heretofore undescribed, and the remarkable series of limestones and dolomites, replete with phenomena significant of their origin and evolution.

WAR SERVICE FOR CHEMISTS

The secretary of the American Chemical Society, Dr. Charles L. Parsons, has prepared the following statement:

So many hundreds of letters are being received from firms and individuals that it is necessary to answer by this form letter, which covers most inquiries.

Individuals can obtain deferred classification only through the local boards or by appeal to the district boards.

Manufacturers engaged in the production of materials necessary for the war may apply by letter to the Chemical Service Section, National Army, Room 1108, Interior Building, Washington, D. C., for the return to them of necessary, trained chemists now in the army and not already transferred to chemical service. They may also apply through the Chemical Service Section for deferred classification of trained chemists necessary to the control of their operations who are not yet called. Applications from the men themselves will not be considered. Only those chemists whose services are necessary to war work will be considered. The evidence submitted by the manufacturers must be conclusive.

Students taking a regular chemical course may be enlisted in the Engineers' Reserve Corps and placed on the inactive list in order to complete their college course. The dean or president of the institution must certify, however, that their standing is such as to warrant the conclusion that they will graduate with a record equal to the first third of the graduates of the previous ten years. This does not apply to students in biological and physiological chemistry, as the Chief of Engineers has ruled that such come under the Surgeon General's Office, rather than under the Engineering Department. Students wishing to take advantage of this opportunity to receive their degrees before entering the country's service should address the Chief of Engineers, War Department, Washington, D. C., asking for the necessary blanks to be filled out for this purpose.

Transfers to chemical service are made by the War Department on request from some division of the army for the particular chemist needed. After the approval of the commanding officer and the Chemical Service Section, the man is transferred. Remember that the Secretary has no power to transfer you to chemical service. He simply brings your name and qualifications before those who have.

No one can predict how great this requirement for chemists will be. At present, although nearly 1,000 chemists are serving in a chemical capacity, some 300 men properly classified as chemists remain in the camps. Accordingly, if you enlist as a chemist before you are called, you will deprive another chemist, actually in the army, of his opportunity to render chemical service. The industries which supply the army and navy with the sinews of war need chemists and are being seriously handicapped by the depletion of their chemical personnel. Cards, giving age, training, experience, etc. (obtained from questionnaires filed with the Bureau of Mines), of all men with chemical training (known to be in the army) are kept in the office of the society. These cards are constantly consulted by those in command needing chemical assistance. Men are chosen, not to give the individual an opportunity to serve in a chemical capacity, but to find the man especially qualified for the work in hand. Accordingly, you may or may not be selected. Men with plant experience, research, physical and organic chemists, some analytical chemists, etc., have been in demand. On the other hand, there has been almost no chance to place pharmaceutical chemists, agricultural or food chemists, as the army apparently has little need for this form of chemical service, and the government itself is not manufacturing in these lines.

Chemical positions in the government service other than those by enlistment in the army and navy are obtainable only through the Civil Service Commission. They do not necessarily exempt the incumbent from military service.

Commissions seek the man. A number of chemists have been commissioned, but in almost every instance it has been by promotion from the ranks for recognized ability, or the particular man has been sought to fill a special place of responsibility or trust for which he was known to be especially fitted. The place was not made for the man, but the man was found for the place, sometimes after long search. A commission carries authority with it and is not lightly awarded, whether in the engineering, medical, or chemical branches of the service.

The War Department has ruled that no class I man may be commissioned before enlistment in a non-fighting branch of the service.

Information regarding individuals is obtained from the questionnaire on file in the Bureau of Mines, Washington, D. C. If you have not filled out one of these questionnaires, write to the Bureau of Mines, asking that one be sent you for this purpose.

When once in the army, keep me informed by post card of your military address and any change in that address, even should you be sent to France. Although you may not be chosen early among those needed for chemical service, the demand for chemists is constantly increasing, and your country may call you at any time where you are best trained to serve.

It is my duty to help place you where you can serve our country best as the need arises. It is your duty to keep me informed of your address and to accept any service to which the War Department may assign you, even if you prefer to fight in the ranks in France.

SCIENTIFIC NOTES AND NEWS

DR. JOHN M. COULTER, professor of botany in the University of Chicago, has been elected president of the Chicago Academy of Science. Professor Coulter is this year also president of the American Association for the Advancement of Science and of the American Association of University Professors.

DR. GEORGE T. MOORE, director of the Missouri Botanical Garden, has been elected president of the Academy of Science of St. Louis, to succeed the late Dr. E. A. Engler.

PROFESSOR THOMAS A. JAGGAR, JR., of the Hawaiian Volcano Observatory, has been elected a non-resident vice-president of the Washington Academy of Sciences.

DR. FRANCIS G. BENEDICT, director of the nutrition laboratory of the Carnegie Institute in Brookline, Mass., has received a gold medal from the National Institute of Social Sciences, in recognition of his "notable service to mankind." The medal was presented at the recent fifth annual dinner of the National Institute in New York City.

PROMINENCE has been given in the press to a story that Dr. Liberty Hyde Bailey, of Ithaca, former director of the College of Agriculture, has been selected by the Democratic chiefs as their candidate for nomination for governor of the state of New York. Mr. Bailey states that this action, if it has been taken, is without his consent, and that he has not been consulted in the matter.

MEMBERS of the Public Health Council, executive officers of the state department of health, and former United States Public Health Service representatives, gave a dinner in honor of Dr. Allen J. McLaughlin, commissioner of health, Boston, prior to his departure to begin work in Washington as assistant surgeon general in charge of the Division of Interstate Quarantine.

A BANQUET in honor of the ninety-fifth birthday of Dr. Stephen Smith, New York, known for his work in medicine and sanitation, was given at the Battle Creek (Mich.) Sanitarium, on February 19. Dr. Smith gave a most interesting account of the changes he had witnessed in the methods of his profession.

THE Mayo Unit, Rochester, of which Major Louis B. Wilson, U. S. Army, is director, with Captains Wayne W. Bissell and Arthur U. Des Jardins as assistant directors, has left for a mobilization point preparatory to sailing for France.

MAJOR BASHFORD DEAN, of the Bureau of Ordnance, has lately returned from a journey to England and France.

DR. R. T. CRAWFORD, associate professor of practical astronomy at the University of California, has been commissioned major in the aviation section of the Signal Corps and has been detailed for duty at the Balloon School at Fort Omaha.

CLARENCE F. HIRSCHFELD, until 1915 professor of power engineering at Cornell University, has received a commission as major in the Ordnance Reserve Corps and is now stationed in the inspection division of the Ordnance Department. He has been with the Detroit Edison Light and Power Company.

DR. PAUL E. KLOPSTEG, of the physics department of the University of Minnesota, has been granted a year's leave of absence for the

purpose of developing instruments for the Ordnance Department for measuring velocities of projectiles.

Dr. R. R. Dykstra, professor of surgery in the department of veterinary medicine of the University of Kansas, has been appointed veterinarian of the Kansas State Board of Agriculture for the year 1918.

Cecil C. Thomas has resigned his position as instructor in botany at the New York State College of Agriculture at Cornell University, to accept an assistantship in plant disinfection with the Federal Horticultural Board of the U. S. Department of Agriculture.

Major Samuel C. Prescott, of the Sanitary Corps, National Army, who is professor of biology at the Massachusetts Institute of Technology, is about to make an extended tour through the cantonments of the South and West.

Dr. Edward Clark, of Buffalo, has been relieved of his duties as acting chief of the division of child hygiene of the state department of health at Albany, and has returned to his former duty as sanitary supervisor of the western part of the state, with station at Buffalo. Dr. Herman F. Senftner, New York City, has succeeded Dr. Edward Clark as the head of the division of child hygiene, pending the release of Dr. Henry L. K. Shaw, Albany, from military service.

Dr. E. H. Leslle has resigned from his position as chief chemist of the General Petroleum Corporation of Los Angeles, and has assumed new duties as technical adviser to the sales department of the U. S. Industrial Alcohol Company and the U. S. Industrial Chemical Company. He will be located in their main offices at 27 William Street, New York City.

Dr. W. K. Fisher, of Stanford University, has been granted leave of absence until August 15 to accompany the University of Iowa's biological expedition to the British West Indies.

Professor Henry C. Sherman, of Columbia University, lectured on February 27, before the Chicago Institute of Medicine upon "Fundamental Requirements in Human Nutrition," and on February 28 spoke to the City Club of Chicago on "America's Food Problem" and to the faculty and students of Illinois University Medical College on "Nutrition and Food Economics."

The annual address of the Alpha Omega Alpha Honorary Medical Fraternity at Western Reserve Medical School was delivered on February 20 by Dr. Roger G. Perkins, professor of hygiene, whose subject was "Medical Conditions in Roumania," Major Perkins has just returned from Roumania with the American Red Cross Commission.

The building for an aeronautical school to be erected at the Carnegie Institute of Technology is to be called the Langley School of Aeronautics, in honor of Samuel Pierpont Langley.

Dr. Samuel G. Dixon, commissioner of the Pennsylvania State Department of Public Health, president of the Academy of Natural Science, formerly professor of hygiene in the University of Pennsylvania, died on February 26, at the age of sixty-six years.

Dr. Arthur H. Elliott, emeritus chief chemist of the New York Consolidated Gas Company and emeritus professor of chemistry and physics in the College of Pharmacy, died on March 2, at the age of seventy years.

Charles A. Hart, systematic entomologist of the State Natural History Survey, died suddenly of heart disease on February 17. He was a member of the American Society of Zoologists.

The death is announced of Professor Christian Hornung, Sc.D., on January 31, 1918, of arteriosclerosis, aged seventy-three years. For fifty years Professor Hornung held the chair of mathematics in Heidelberg University, Tiffin, Ohio. He is referred to as "a distinguished scholar, author of mathematical texts and correspondent of many noted astronomers and mathematicians and a member of the national societies devoted to his profession."

The Rev. A. T. G. Apple, M.A., died in Lancaster, Pa., on February 5, of angina pectoris, aged fifty-eight years. For the past eleven years Professor Apple has been pro-

fessor of mathematics and astronomy in Franklin and Marshall College and director of the Scholl Observatory. A correspondent writes: "He was an indefatigable worker and his publications on Jupiter brought him recognition both in this country and abroad. The observations and calculations in connection with this work and also that on the double stars, have been used in the Government Almanac. Professor Apple was a member of the American Astronomical Society, the British Astronomical Association and a fellow of the American Association for the Advancement of Science."

LIEUTENANT E. J. WOODHOUSE, until recently economic botanist to the government of Bengal, has died from wounds received in action in France.

THE death, at the age of fifty-eight years, is announced of Dr. G. Lepage, professor of obstetrics in the University of Paris.

THE Rockefeller Foundation has appropriated $125,000 to continue the war demonstration hospital of the Rockefeller Institute, $50,000 for the work of the medical division of the National Research Council of the Council of National Defense and $12,281 for other medical war research and relief work.

DR. T. MITCHELL PRUDDEN, emeritus professor of pathology in Columbia University, who has spent many years in the study of the small ruins of southern Colorado, has presented to the American Museum of Natural History a collection of pottery and other objects acquired during the course of his work. Dr. W. L. Hildburgh has presented to the museum a very carefully selected collection of archeological objects from New York state, containing some fine Iroquois pots and pipes. Dr. Hildburgh, known for his work in anthropology, has resided for a number of years in England.

A "GENERAL Congress of Civil Engineering" will be held in Paris on March 18–23 next. The objects of the conference, as recently explained to the French Minister of Commerce and Industry and quoted in *Nature*, are to awaken the French nation to the need for increased industrial enterprise and the attainment of industrial agreement. The Minister expressed the hope that the conference would give very close attention to such questions as the saving of fuel and the thorough utilization of intellectual and mechanical effort; wage war on waste of all kinds; and advocate the systematic utilization of by-products, and the adoption of improved scientific mechanical methods of production—in short, give that place to applied knowledge that it now merits.

THE California Academy of Sciences announces that the course of popular scientific lectures is being continued on Sunday afternoons at three o'clock in the auditorium of the Museum in Golden Gate Park as follows:

February 17. Professor E. G. Linsley, department of geology and astronomy, Mills College, "Our nearest neighbor, the Moon." Illustrated.

February 24. Dr. F. W. Weymouth, department of physiology, Stanford University, "The crab fisheries of the Pacific coast." Illustrated.

March 3. Professor Harold Heath, professor of zoology, Stanford University, "The Pacific whale fisheries." Illustrated.

March 10. Mr. Ralph Hopping, U. S. Forest Service, "Pine insects and their depredations."

SENATOR OWEN introduced into the Senate, and Representative Dyer into the House of Representatives, the following bill regarding rank of the Medical Reserve Corps of the Army:

That hereafter the commissioned officers of the Medical Corps, and of the Medical Reserve Corps of the United States Army on active duty shall be distributed in the several grades in the same ratios heretofore established by law in the Medical Corps of the United States Navy.

The Surgeon-General shall have authority to designate as "consultants" officers of either corps and retire them as the interests of the service may require.

SECRETARY of the Interior Lane has designated Bartlesville, Okla., as the location of the new experimental station of the Bureau of Mines for the investigation of problems relating to the petroleum and natural gas industries. The station is one of three new experi-

mental stations for the establishing of which the sum of $75,000 was appropriated by the last Congress. The two other stations have been located at Minneapolis, Minn., for the study of iron and manganese problems, and at Columbus, Ohio, for research connected with the ceramic and clayworking industries. The selection of Bartlesville was due to its location in the heart of the great mid-continent oil and gas field. The selection was influenced also by the offer of a free site and by the raising of $50,000 by the citizens of the town. This sum of money will be applied to the building of offices and laboratories and the purchase of engineering and chemical equipment. The technical staff of the new experimental station will study various problems having practical commercial application to the petroleum and natural gas industries, including questions of production, transportation, storage and refining of petroleum and various problems connected with the technology of natural gas. One of the greatest needs of the petroleum industry has been the coordination of scientific research with the practical side of the industry, for compared with other mineral industries it has been singularly backward in this respect. The station is aimed to act an intermediary between the facts evolved by scientific investigations and the needs of the oil industries. That is, men will be employed who will be able to gather scientific data and find out how they may be applied to the practical needs of the industry.

Jacob T. Bowne, librarian of the Young Men's Christian Association College, has given his anthropological collection to the Springfield Museum of Natural History. The collection consists of some thousands of objects with complete catalogue giving the history of each object and the conditions under which it was found, with many bibliographical references to further sources of information. Mr. Bowne has spent fifty years in the study of primitive man, laying special emphasis upon the North American Indian, and the greater part of the collection is made up of relics of the Indians of the Connecticut Valley within twenty miles of Springfield. The specimens of Indian handiwork in stone, bone, shell and pottery were gathered from sites of ancient camps and burial places in this immediate vicinity. In addition to the objects. Mr. Bowne's gift includes several hundred books on anthropology, some of them very rare, together with archeological cabinets, manuscripts, maps and diagrams. The collection will remain in Mr. Bowne's keeping for the present. In accepting the collection for the museum, the directors passed the following resolution:

Resolved, That the directors extend to Mr. Jacob T. Bowne the hearty and appreciative thanks of the City Library Association for the gift of his extensive and finely organized anthropological collection, which is the result of many years of assiduous and discriminating study. The collection, relating especially to the North American Indian type and more particularly to the Indian of the Connecticut valley within 20 miles of Springfield, including the remains of aboriginal handiwork in stone, bone, shell and pottery, gathered from the sites of ancient camps and burial places in this immediate vicinity, forms a most desirable accession for the museum of natural history. The citizens of Springfield are deeply indebted to Mr. Bowne for his generosity in making this public gift.

UNIVERSITY AND EDUCATIONAL NEWS

The Carnegie Corporation has presented McGill University with $1,000,000 in recognition of the institution's "devoted service and sacrifice towards Canada's part in the war."

In the State University of Iowa this year, not a single undergraduate in the College of Liberal Arts qualified for the Sigma Xi. Although students are taking their studies more seriously than in former years the records show that the ablest students have been drawn into war service.

Dr. Russell A. Hibbs, of the University of Louisville, has been appointed professor of orthopedic surgery in the college of physicians and surgeons of Columbia University. Dr. Eugene W. Caldwell, of Bellevue Hospital Medical College, has been appointed to the newly established chair of roentgenology. Dr. Vera Danschakoff, formerly of Moscow, has been promoted to be assistant professor of

anatomy and Dr. I. H. Goldberger, has been appointed special lecturer of child hygiene in the school for oral hygiene.

MR. ARTHUR C. WALTON, M.A. (Northwestern '15), M.A. (Harvard '16) has been made acting professor of biology in the chair made vacant by the death of Professor Umbach. Mr. Walton holds a Harvard traveling fellowship and had planned work in Sweden but was prevented by the war.

FRED G. ALLEN, of Erie, Pa., a graduate of the University of Toronto, has been appointed assistant professor in electrical engineering at Lafayette College to take the place left vacant by the resignation of E. D. Tanzer, who has become assistant professor of electrical engineering at the Georgia Institute of Technology.

EARLY in January Miss Margaret Heatley, instructor in botany at Wellesley College, sailed for South Africa to take charge of the botanical department in Huguenot College of Cape Colony during the absence on sabbatical grant of Dr. Bertha Stoneman. Miss Alice M. Ottley, who was absent on leave, has returned to Wellesley College to fill the vacancy in the botany department caused by Miss Heatley's absence.

DISCUSSION AND CORRESPONDENCE

NOTE ON THE GEOMETRICAL MEAN AS A B. COLI INDEX

IT is always a beneficial means of grace for a scientist to wander into paths outside his own domain; such excursions often reveal too the lack of coordination between the various sciences, although happily there has been great progress within the past two decades in this respect. These remarks are evoked by a reading of the note by William Firth Wells: "The Geometrical Mean as a *B. Coli* Index" in SCIENCE for January 11.

The first impression gained is the lack of a clear presentation of the method. The notion of a geometric mean is purely mathematical, but it must be said that to a mathematician, even to one fairly conversant with the theory and methods of bacteriological analysis, the theory on which this method rests is not at all in evidence, save only perhaps in the remark that "the ordinary bacteriological dilution scale is in reality a logarithmic scale." It does not, however, follow necessarily that the most probable number of *B. coli* is the geometric mean as obtained by Mr. Wells. In support of this contention, see a thoroughly mathematical treatment of the whole question by M. H. McCrady,[1] of the laboratories of the board of health of the Province of Quebec; the formulas there derived show that the logarithmic function is more complicated than Mr. Wells perhaps has in mind. His experimental data may, on the other hand, show that his proposed method will serve well as a "first approximation."

The second impression coming from a study of the article is the feeling that this method merits a mathematical treatment. It seems to be essentially as follows: Five sets of twenty tubes each, containing portions of the sample in powers (not "multiples") of ten, are tested for the presence of gas, indicating the presence of *B. coli*. For the dilutions 10 c.c., 1 c.c., .1 c.c., .01 c.c., .001 c.c., graded with the scale numbers 0, 1, 2, 3, 4, respectively, the number of tubes showing presence of *B. coli* was 20 18, 8, 1, 0, respectively, the experiment having been extended from a dilution at which all tubes gave positive results to one in which no tube gave such a result. In going from the weakest dilution to the next higher there was a *gain* of one tube, next a gain of 7, then of 10, then of 2. The scale numbers, which appear to correspond to the logarithms of certain hypothetical most probable numbers of *B. coli* for the separate dilutions, are averaged with the foregoing gains used as weights, *i. e.*, 2, 10, 7, 1, 0; and the weighted mean thus found corresponds to the logarithm of the desired most probable average number of *B. coli*. In other words, the weighted geometric mean of the above-mentioned hypothetical numbers of *B. coli* is taken as the desired average.

An immediate consequence of the mathematics involved is that the same result is

[1] M. H. McCrady, "The Numerical Interpretation of Fermentation-Tube Results," *Journal of Infectious Diseases*, Vol. 17, No. 1, January, 1915, pp. 183–212.

always obtained by dividing the sum of all the positives except the highest by the highest, *e. g.*, 1/20 (18 + 8 + 1 + 0) = 1.35. That a mathematical treatment would improve and standardize the computation can be seen from the remark that a hasty study gives the following simpler result (subject to the doubt already expressed as to the validity of the theory): The aggregate per cent. of "positive" tubes gives the logarithm of the most probable average number of *B. coli* per 100 c.c., *e. g.*, 1/20 (20 + 18 + 8 + 1 + 0) = 2.35, and this is the logarithm of 224. This rule will explain, for example, why Mr. Wells's "reversion method" works, for it is the mathematical equivalent of the foregoing. A further implication is that the author would seem to be wrong in saying that the "percentage positive" (the aggregate percentage) gives the desired result for a test using a single dilution; to use a concrete example, 18 positives out of 20 at 1 c.c. together with 0 positives out of 20 at .1 c.c. should by any test be regarded as indicating a smaller number of *B. coli* than the 18 positives alone, yet the rule here commented on yields the same results for both.

It will be of undoubted value to have Mr. Wells's more complete presentation particularly of the experimental data which he mentions.

W. D. Cairns

Oberlin College,
Oberlin, Ohio

SOME DEFECTS IN OUR AGRICULTURAL INSTRUCTION

In the preface to the text-book on agricultural botany ("Traité de Botanique Agricole et Industrielle") by J. Vesque, professor of agricultural botany in the National Institute of Agronomy of France, the following criticism on the agricultural instruction then (1885) given in France occurs:

> In France the agricultural instruction attaches itself more and more to rearing of livestock. It is too much forgotten that the animals are nourished by the plants, or, if it is not forgotten, it is taken for granted that the culture of plants consists merely in the production of a maximum mass of vegetables. The nature of the plants, the species which populate our fields, the seeds confined to the soil are far from preoccupying the cultivator as much as the nature of the soil and the fertilizers employed. All the agricultural instruction may at this point be summed up in three words: Zootechny, agricultural chemistry and rural engineering. The plant, the initiative in all agricultural pursuits, is almost excluded. How many cultivators know the herbs of their farms, how many are capable of distinguishing the good from the bad? Liebig was certainly not wrong in accusing the students of the agricultural schools of knowing neither the seeds of the grasses nor the grasses themselves.

These remarks, describing the character of the agricultural instruction in France in 1885, fit the condition prevailing in many of our American agricultural colleges at the present day to a strange degree of exactness. The same neglect of the scientific knowledge of plants is present, not only in courses in which animal industry is the major subject, but even in such courses as agronomy and horticulture, which from their very nature should deal largely with plants. We find the botanical equipment of the average graduate very meager indeed. He has not infrequently been the recipient of long lecture courses on forage plants without possessing definite knowledge of the distinction between grasses and legumes; or he has studied ornamentals in his horticultural courses without enough training in botany to appreciate either the meaning of the description of a plant or the importance of its scientific name; or he may have spent considerable time in judging corn without having clearly in his mind to which family of plants the Indian corn belongs, or what characteristics distinguish it from the other members of its family. Such vague knowledge of plants is not uncommonly met with among graduates from agricultural colleges claiming thoroughness for their preparation.

No one will deny the right of agriculture to the title of a generous place in the higher education, based as it is on those natural sciences, in which our country claims its proudest distinction in its progress. It is also undoubtedly the intention of all these agricultural colleges,

due to the land grant act, to furnish this higher education, for the equipment of which they are liberally supported by the state and national means. The claims upon the preparation for entering these colleges are also about the same as that required by schools of the higher order, or the university class, that is high-school graduation, or its equivalent. But in spite of these advantages and the numerous special courses offered by nearly all these colleges, a great many of our graduates are suffering from the deficiencies complained of by Professor Vesque, thirty years ago in France.

In glancing over the catalogues of the courses of the agricultural instruction given in these colleges, one is struck by the multitude of optional courses, which are frequently restricted to very narrow specialties. The time allotted to one of these petty subjects is frequently as much as that given to the whole of the science of botany, which constitutes one of the main foundations of the entire structure of higher agricultural education.

In further examining these special courses, we shall find that many of them presuppose a careful preparation in botany which, however, has not been granted by the general curriculum. It is not infrequent that a student in some of these colleges is receiving lectures in plant breeding without previously having received any instruction, worth his while, either in morphology or taxonomy. An examination of the curriculum of many of our agricultural colleges seems to reveal the fact that there is too much specializing upon the superstructure before a safe foundation is laid. If the student be equipped with a fair general knowledge of botany, chemistry and physics, including physical chemistry, he may be trusted to develop the specialties of agriculture resting upon these as opportunity and occasions arise, but if the fundamentals be lacking, he will always remain uncertain and giddy.

H. NESS
TEXAS EXPERIMENTAL STATION

PROFESSIONAL COURTESY

TO THE EDITOR OF SCIENCE: We appreciate your courtesy in submitting to us the criticism concerning ethics involved in the publication of the article referred to by Professor Hart. We do not feel that a reply to the charges contained in his statement is necessary, further than to say that the work referred to was planned entirely by one of us (McCollum) and was carried out by Mr. Steenbock, according to the usual practise in experimental work. The detailed records of the time of extractions, filtrations, evaporations, etc., were published verbatim from notes copied by Mr. Steenbock for me as requested, and should, of course, correspond closely with his notebooks.

In a case of this kind where the veracity of one of the statements must be questioned by those who read this charge and our reply, nothing better can be done than to leave the public to judge for itself on the basis of the research records of all concerned as to the probable responsibility for the planning of this work.

E. V. MCCOLLUM,
N. SIMMONDS

SCIENTIFIC BOOKS

Societies of the Plains Indians. Anthropological Papers of the American Museum of Natural History. Volume XI. New York, 1916. Edited by CLARK WISSLER. Issued in 13 parts; C. WISSLER, R. H. LOWIE, P. E. GODDARD, A. SKINNER, J. R. MURIE, contributors.

This volume probably does not represent the greatest undertaking in modern American ethnology: it does represent one of the most efficiently executed, and is therefore of interest as an example of the method to which the science has attained. In case the designation "science" seem as yet unearned, let us compromise on "study of uncivilized culture history."

There are still many students at the height of their activity who were trained in, and some who practise, the older ethnology: a discipline begot by an intrinsic interest in the phenomena of culture, but fathered and nourished by the doctrine of evolution after it had begun to transcend its proper biological

source; and leaning as heavily as unconsciously on a kind of crude lay psychology of the individual. So strong was the impress of the idea of an unfolding sequence inhering in phenomena themselves, in this earlier ethnology or self-styled "science of man," that the actual relations of its phenomena in time and space were rarely looked into systematically. In consequence, its causal factors were determined with equal randomness. The explanations of causality of which the evolutionary anthropology of a generation ago consisted, were hypothetical and plausible.

The element of time, easily recoverable, at least as regards its relative phases, in prehistory and most fields of archeology, can be only indirectly reached in ethnology proper, which deals with living peoples innocent of writing. Ordinarily, all that we have of them is a momentary cross section of the long stream of their customs. Obviously, the course of this channel can be reconstructed factively only through a detailed determination of the data in terms of some other element which may subsequently be converted into factors of time. This other element is that of space; or, as it is usually named in this connection, geography. Experience to date has revealed no other method, except the speculation, mystical or rationalizing, concealed or avowed, of the older workers.

The spatial factors were strongly appreciated by Ratzel and his school, though still partly in terms of formal physical geography. Chance, however, brought it that in this country a body of students less driven through their general social environment to attempt interpretation than their European colleagues, found themselves envisaged at arms' length, as it were, by a mass of first-hand and living ethnological data. Once these were tasted, they proved emotionally palatable to many minds; with the result that materials were gradually accumulated on a really enormous and unprecedented scale.

It is curious how slowly the realization of this opportunity dawned. Ethnology was practised in this country fifty and seventy-five years ago, and if the students were less in number, they were, man for man, probably more illustrious, as the names of Hale, Gallatin, Morgan, Brinton, and Powell attest. These eminent men truly conducted researches, where many a successor has done little more than assemble material. But the personal contact of all of these pioneers with the Indians at their door was limited, and several disdained it wholly. The explorer, the traveler, the missionary, the military leader, sometimes the compiling historian or instituting official of civilization, were their purveyors of substance. Only slowly was it felt that as good and far better information could be got by the inquirer whose business was ethnic knowledge than by the voyager or resident whose purpose was incidental, and that such acquisition, instead of being an arduous preliminary task, was in itself a grateful pleasure. Much of the old native life long resisted the brunt of our civilization; an infinitude more lay immediately below the surface. The Indian, far from impeding serious inquiry, in most cases was only interested in facilitating it. An enormous tribal diversity lent the color of variety to every increasing endeavor. And, as the spread of the frontier and the education of the Indian tended to obliterate the continuance of native custom, they also rendered access to the people, and intelligent communication with them, easier, less expensive, and more profitable. To-day, the generation of American ethnologists is reared in field studies. Its novices take work on an Indian reservation for granted as the first step on the professional ladder. It is true that acquisition for a time so far outstripped utilization that the reproach was sometimes leveled from transatlantic quarters that purpose had been forgotten and direction lost. But it is equally important to realize that no equally extensive and continuous body of detailed ethnic data has ever been accumulated on the primitive people of any other area as on those of the United States, Canada, and Alaska.

In time, the mere mass of material forced its classification; and its arrangement by types

proved to be essentially an arrangement in space also, in practically every instance. The factor of distribution became as inescapable as in biology, and was recognized as far more momentous than had hitherto been the case in the depiction of non-literary peoples. From distributions to diffusions was only a step that forced itself on the attention; in technical language, the "culture area" began to be replaced by the "culture center" as a working tool. And any diffusion already sets us in time as well as space; with the results that ethnology is beginning to be back at the sequences with which it commenced—but now painstakingly arrived at and laboriously solidified instead of speculatively leaped at.

An example is the present volume on "Societies of the Plains Indians." The older ethnologist vaulted the gap between a tribe in Mexico and one in Alaska, or slipped between the beginning and end of a sentence from ancient Greece to modern Australia as if his bridge of fancy were one of traveled fact; and his next colleague—there were no collaborators—rambled or flew where he listed. The student of to-day begins by associating himself with colleagues. They plan an inquiry, not into a universal phase of human activity, nor of the American Indian, but of the formal religious associations of one group only of North Americans, the closely similar tribes of the Plains. They are nine years securing their material and four presenting and analyzing it; and it bulks to a thousand pages. This may seem a rioting welter of technicality. The laymen would prefer a handy pocket volume that told him incisively who the Indian was, whence and how he came, the consistent scheme of his society, the nature of his religion, and how both originated. There is no answer, nor attempt to answer, even one of these quesetions in the present work. Its thirteen parts describe the associational organization of the religion of sixteen tribes, or, with those on which adequate information happened previously to be extant, all of any importance within the cultural limits of the Plains. The type of each tribal religion is defined; interrelations elucidated; and the two concluding comparative sections by Drs. Wissler and Lowie finally settle into pure history in the most rigid sense of the term.

Thus, in his "General Discussion of Shamanistic and Dancing Societies," Dr. Wissler gives a family tree of the Iruska ceremony and associations connected with it. He succeeds in tracing this to a Dakota rite known as the Heyoka, which, with the addition of certain Omaha features, was taken by the Pawnee and worked into the Iruska proper. This traveled back to the Omaha and from them to the Dakota, who, by adding a new and vigorous series of songs, popularized the ceremony as the Grass Dance, and gave it to a long array of tribes. One of these, the Potawotomi, some twenty years later, added still farther to the religious "complex," and, as the Dream Dance, passed it on to another group of tribes. These were marginal or exterior to the Plains, distinct in their religious assumptions from the Plains tribes proper, and obviously took up the made over form of the ceremony because it was made over. A number of peoples accepted the "Iruska Trait-Complex," as the author calls it, twice in their and its careers; the Iowa even received and followed it three times, as Iruska proper, Grass Dance, and Dream Dance. It is of interest that as a rule the natives were well aware of the filial relationship between an earlier and later form of the cult.

It is clear that what we have here is history as historical as any following out of the origins and growth of Christianity or the Papacy or Parliamentary government, but reconstructed by circumstantial evidence derived from materials furnished by a group of peoples without annals, documents, or a scrap of writing. It is also evident, while the world will never be deeply moved by the Iruska cult or by the activities of the Pawnee in the nineteenth century, that studies such as this are uncovering principles of broad applicability—principles of a psychology that is truly social, and that in a greater or less degree must ultimately be met and recognized by every historian or analyst of human civilization.

Similarly, Dr. Lowie in his comparative study of the Age Societies—religious bodies grouped or graded according to the age of their members—although dealing with a set of institutions much older than the Iruska ceremonies, in fact far antedating the advent of the Caucasian in the region, establishes that the age-grade societies are an outgrowth of a system of non-graded societies still prevailing among the majority of Plains tribes; that the grading originated among either the Mandan or Hidatsa; and that the scheme spread from them respectively to the Arapaho and Gros Ventre and to the Blackfoot at a time when these peoples were in closer contact with the Mandan-Hidatsa than has been the case within the historic period. Again, the outcome of the investigation is a specifically founded reconstruction and a definite tracing of the sequence of events.

Dr. Lowie concludes by testing against these positive determinations a theory devised according to the old method by Schurtz, purporting to discern age societies as an institution arising spontaneously and necessarily at a certain stage of development of human civilization. As a wholly abstract speculation, the Schurtz hypothesis is scarcely assailable and equally useless. Matched against the analyzed facts in the Plains of North America, in Melanesia, and in East Africa, it breaks down and dissolves utterly. In fact Dr. Lowie shows convincingly that the age societies in these regions are not identical nor even parallel but represent diverse causes, diverse characters, and diverse sequences. Their uniformity and the supposed "laws" governing them are in the assumptions of the theorizer, not in the events.

This, it may be added, is the type of finding that invariably emerges when a critical and inductive examination is made of any of the smooth explanations that were the crop of the anthropology of half a century ago, and which are still the inviolable stock in trade of the anthropology dealt out in the Sunday newspapers, the drawing room, the books on "social evolution" and the mass of semi-scientific, unscientific, and pseudo-scientific literature that sets solution before inquiry. The matriarchate, the priority of female lineage, the antecedence of the clan to the family, promiscuity and group marriage, the fundamentality of the totem idea, the mana concept as the basis of religion, the development of alphabets from pictures, of geometric ornament from symbols, strange vestigial survivals generally—all these delightfully exotic, fascinatingly romantic, and often alluringly shocking views that have given anthropology most of its broad appeal, have their glitter crumble into dust as soon as critical method is applied to them. To most ethnologists of his own school, Dr. Lowie's elaborate demolition of the Schurtz speculation may seem unnecessary. Its wider significance is as a symptom of the growing conversion of anthropology from the toy of fanciful half scholarship to a product of scientific method.

Finally, too great credit can hardly be bestowed on the institutional side upon the American Museum of Natural History, its anthropological department, and Dr. Wissler, for the clean, business-like, and effective manner in which the undertaking represented in this volume was planned, carried through, and concluded. Without announcement or formal flourish an important scheme was formulated, put into operation year after year, systematically but never unbendingly adhered to, with cumulative results, and concretely accomplished through the cooperating efforts of a staff of five participating students, one of them a member of the native race whose institutions formed the subject of the inquiry. The parts of the volume were published promptly, the summaries undelayed, the typography, illustrations, and index are of the best. The record is one with which the Museum may well be content administratively as well as scientifically.

A. L. Kroeber

THE PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES

The eleventh number of Volume 3 of the *Proceedings of the National Academy of Sciences* contains the following articles:

A necessary and sufficient Condition for the Existence of a Stieltjes integral: GILBERT AMES BLISS, Department of Mathematics, University of Chicago.

Transformations of Applicable Conjugate Nets of Curves on Surfaces: Luther Pfahler Eisenhart, Department of Mathematics, Princeton University.

On Bilinear and N-Linear Functionals: Charles Albert Fischer, Department of Mathematics, Columbia University.

The Crystal Structure of Chalcopyrite Determined by X Rays: Charles L. Burdick and James H. Ellis, Chemical Laboratories, Throop College of Technology. Chalcopyrite belongs to the tetragonal system of crystals, few of which have been examined for structure. The lattice is of the face-centered type.

The Isostatic Subsidence of Volcanic Islands: W. M. Davis, Department of Geology and Geography, Harvard University. Darwin's primary theory of coral reefs holds good, although his supplementary theory of broad ocean-floor subsidence needs modification.

On the Deformation of an N-Cell: Oswald Veblen, Department of Mathematics, Princeton University.

A Theorem on Series of Orthogonal Functions with an Application to Sturm-Liouville Series: George D. Birkhoff, Department of Mathematics, Harvard University.

Low-Temperature Formation of Alkaline Feldspars in Limestone: Reginald A. Daly, Department of Geology and Geography, Harvard University. A review of recent European literature and a discussion of American Rocky Mountain dolomite.

The Interferometry of Small Angles, etc. Methods by Direct and Reversed Superposed Spectra: Carl Barus, Department of Physics, Brown University.

The twelfth number of Volume 3 contains the following articles:

Incompatibility of Mutant Races in Drosophila: C. W. Metz and C. B. Bridges, Carnegie Station for Experimental Evolution, and Columbia University. The evidence from two cases of incompatibility in laboratory cultures taken with evidence from apparently mutant forms and incompatible varieties of nature tends to remove a serious objection to the mutation hypothesis and emphasizes the possible evolutionary importance of mutations involving incompatibility.

Absorption Effects in the Spiral Nebulæ: Heber D. Curtis, Lick Observatory, University of California. Negatives of spiral nebulæ obtained with the Crossley Reflector show that the phenomenon of dark lanes caused by occulting or absorbing matter is much more frequent than has been supposed. The results may bear directly on the explanation of the peculiar grouping of the spirals.

The Synergetic Action of Electrolytes: Oran L. Raber, Laboratory of Plant Physiology, Harvard University. Synergy is the opposite of antagonism; although antagonism is frequently reported, few cases of synergy have been noted.

Appetites and Aversions as Constituents of Instincts: Wallace Craig, University of Maine, Orono. Although innate chain reflexes constitute a considerable part of the equipment of doves, few or none of their instincts are mere chain reflexes. On the contrary each instinct involves an element of appetite, or of aversion, or both.

Rapid Respiration after Death: A. R. C. Haas, Laboratory of Plant Phsiology, Harvard University. The respiration of *Laminaria* may be much greater after death than in the normal condition.

The Means of Locomotion in Planarians: Caroline E. Stringer, Zoological Laboratory, Radcliffe College. The locomotion is essentially a muscular act in which the cilia play no necessary part.

Diurnal Changes in the Sea at Tortugas, Florida: J. F. McClendon, Department of Physiology, University of Minnesota and Tortugas Laboratory, Carnegie Institution of Washington.

Note on Interferometer Methods of Measuring the Elastics of Small Bodies: Carl Barus, Department of Physics, Brown University.

Sublacustrine Glacial Erosion in Montana: W. M. Davis, Department of Geology and Geography, Harvard University. Clark fork branch-glacier seems to have done its visible erosive work on the valley-side spurs—and presumably a considerable amount of invisible work on the valley bottom—although it must have been wholly submerged in Lake Missoula for two or three score, if not for four score miles.

The Effect of Stretching on the Rate of Conduction in the Neuro-Muscular Network in Cassiopea: J. F.McClendon, Department of Physiology, University of Minnesota and Tortugas Laboratory, Carnegie Institution of Washington. Apparently stretching the nerve does not change the rate.

A Criticism of the Evidence for the Mutation Theory of De Vries from the Behavior of Species of Oenothera in Crosses and in Selfed Lines: Bradley Moore Davis, Department of Botany, University of Pennsylvania. Although most of the genetical work on œnotheras has not been interpreted in Mendelian notation, there is clear evidence of order in the results in inbreeding and crossing: the difficulty has been to discover and to isolate simple material in the confusion of mixed and impure forms of these plants.

The Spectra of Isotopes and the Vibration of Electrons in the Atom: William D. Harkins and Lester Aronberg, Kent Chemical Laboratory and Ryerson Physical Laboratory, University of Chicago. The spectra of isotopes have previously been reported as identical within the errors of measure. The authors find, however, a slight difference. The wavelength of uranio-lead was very slightly longer than that of the ordinary lead.

The Effect of Oxygen Tension on the Metabolism of Cassiopea: J. F. McClendon, Department of Physiology, University of Minnesota and Tortugas Laboratory, Carnegie Institution of Washington.

National Research Council: Scientific Publications from Germany; Report of the Geology and Paleontology Committee; First Report of Committee on Zoology; The Scope and Work of the Botanical Raw Products Committee; Meetings of the Executive Committee.

List of Publications of the National Academy of Sciences.

Report of the Autumn Meeting: Business Session; Scientific Sessions.

We may summarize the articles in Volume 3 of the *Proceedings* as follows: Mathematics, 13; Astronomy, 17; Physics and Engineering, 32; Chemistry, 12; Agriculture, 4; Geology and Paleontology, including Oceanography, Mineralogy and Petrology, 18; Botany, 5 (see also Genetics); Zoology, including General Biology, 27 (see also Genetics); Genetics, 11; Physiology and Pathology, 18; Anthropology and Psychology, 5; a total of 162 articles.

The division of these articles between members of the academy and non-members is 49 and 113 respectively.

The list of institutions which have contributed three or more articles is as follows: Carnegie Institution, 32, divided as follows: Solar Observatory 13, Marine Biology 7, Station for Experimental Evolution 6, Tortugas Laboratory 5, Geophysical Laboratory 1; Harvard University 26; Brown University 9; Yale University 7; University of Chicago 6; University of Illinois 5; Princeton University 5; Rockefeller Institute for Medical Research 4; U. S. Department of Agriculture 4; Johns Hopkins University 4; University of Virginia 4; General Electric Company 4; American Museum of Natural History 3; Columbia University 3.

Edwin Bidwell Wilson
Mass. Institute of Technology,
Cambridge, Mass.

SPECIAL ARTICLES

RESULTS OF CORN DISEASE INVESTIGATIONS

A preliminary summary of three years' investigations of certain little understood corn diseases made in Illinois and Indiana, includes some interesting facts which the writers desire to present at this time. This study has been conducted both in the field and in the laboratory. A more complete statement of the results will be published in the near future.

These studies are all based on the ear-to-row test. Dent corn only was used in these tests. They are not conclusive, but indicate the lines of attack, and this statement is presented at this time to call attention to the fundamental relation of these investigations to seed selection and the germination test. Approximately a hundred and fifty readings have been made on the mother-ear, seed, seedlings, and field performance of each of the ears. No ears are referred to herein which did not have a hundred per cent. germination record. The germination records are based on twenty kernels from each ear. The report of this year's work is corroborated by the results of the two previous years.

Some of the most important results of the experiments are:

(*a*) That barren stalks and stalks bearing only nubbins seem to be correlated with certain pathologic conditions in the plants. There is also a correlation between certain types of seedlings grown on a neutral-base germinator and the number of barren stalks that grow from the seed planted from the same ears.

(*b*) That in fifteen rows of corn grown this season from ears which present this pathologic condition in the seedlings, there were 15.2 per cent. of the plants barren, and 6.2 per cent. of the stalks bore nubbins only. In these rows 15.2 per cent. of the stalks were down by the end of the growing season. In fifteen rows of corn grown from ears not having seedlings which showed this pathologic condition, 6.3 per cent. of the stalks were barren, and 3.4 per cent. bore nubbins only. In these rows 3.1 per cent. of the stalks were down at the end of the growing season.

The computed difference in yield between these two series of rows was 22.6 bushels per acre. The rows were distributed throughout the test plot, the high-yielding and diseased rows alternating.

(*c*) That this pathologic seedling type is developed both on the neutral-base germinator and in sterile agar flask cultures.

(*d*) That surface sterilized seeds harbor bacteria and species of *Fusarium*. The bacteria cause a rotting of the seedling root tips in the sterile flask cultures. This rotting of the roots of the seedlings is the germination characteristic of the ears of corn which develop the greatest numbers of barren and down stalks in the field.

(*e*) By controlling fertilization by hand pollinating ears of apparently disease free plants with pollen from similar plants, the amount of barrenness in the rows from these ears was reduced to less than 1.5 per cent., and with but 1.2 per cent. down-stalks at the end of the growing season.

(*f*) All kernels from the same infested ear do not harbor pathogenic organisms within them. Neither is the rate of seedling development usually referred to as "vitality," a criterion for assuming freedom from infestation of the seed by bacteria and species of *Fusarium*. The rate of seedling development on the germinator is not indicative of the yield possibilities of that seed ear.

G. N. HOFFER,
PURDUE UNIVERSITY, LAFAYETTE, IND.

J. R. HOLBERT,
FUNK SEED CO., BLOOMINGTON, ILL.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SECTION F (ZOOLOGY)

THE Convocation Week meetings of Section F (Zoology) of the American Association for the Advancement of Science were held in conjunction with those of the American Society of Naturalists at Pittsburgh, Pa., December 31, 1917, and January first, 1918. The meetings of Monday, December 31, were in charge of the officers of Section F and were presided over by Professor Herbert Osborn, professor of zoology in the Ohio State University and vice-president of Section F. In the absence of the secretary of the Section, Professor W. M. Smallwood, of Syracuse University, acted as temporary secretary.

At the business meeting of the Section, Professor L. B. Walton, of Kenyon College, was re-elected member of the council; Professor V. E. Shelford, of the University of Illinois, was chosen member of the sectional committee for five years; Professor C. H. Eigenmann, of Indiana University, was elected member of the general committee.

At the meeting of the sectional committee Professor William Patten, of Dartmouth College, was nominated as vice-president of the section for the ensuing year, and Professor Herbert V. Neal, of Tufts College, was reelected secretary of the Section for five years.

The following resolution, presented by Professor H. B. Ward, was unanimously adopted by the Section:

In the opinion of Section F it is important that in any plans formulated or arranged by the American Association for the Advancement of Science looking toward the organization and development of national or international bibliographic projects, the existing international bibliographic undertaking for zoology, *i. e.*, the Concilium Bibliographicum in Zurich, long approved by this Association and in part supported by numerous grants from its funds, be kept definitely in mind and included in any plan for bibliographic work presented for consideration by the special committee of the council.

The Section voted to recommend that the association make a grant of $1,000 to Professor C. H. Eigenmann, of Indiana University, for the study of South American fishes.

Owing to the absence of Professor G. H. Parker, of Harvard University, the address of the retiring vice-president was not given. The address—upon "Some underlying principles in the structure of the nervous system" has appeared in Science (Feb. 15). The following papers were read:

1. *Some pathological phenomena following inhalation of chlorine gas:* H. R. Hunt and W. H. Schultz, West Virginia University.

The lungs of animals killed with chlorine gas show the following characters differing from those found in normal lungs:

1. Depending upon time of exposure and upon concentration of gas inhaled, chlorine gas causes an abnormal distribution of blood and fluid in the lungs. In more or less localized areas of lobules, there are varying degrees of congestion of arterioles. This may be associated with edema and hemorrhage causing hepatization.

2. Histological study of hepaticized areas shows the following pathological conditions:

(*a*) The arterioles of gassed lungs are filled with blood, often under such tension as to render the elastica interna nearly free from folding. There seems to be a concentration of cellular elements and a diminution of fluid content in the arterioles.

(*b*) The media and adventitia of congested arteries are edematous causing considerable thickening of these layers.

(*c*) The capillaries frequently show small islands of corpuscles which apparently have been caught and retained in what appear to be constricted vessels and the arterioles supplying these vessels are greatly congested.

(*d*) The nuclear membrane of "fetal cells" seems slightly irregular. It stains more deeply with hematoxylin, the nuclear material appears clumped into larger granules and the cytoplasm is less plump than normally. The latter takes on a bluish tinge with hematoxylin. Further study of the respiratory cells is necessary, but the indications are that chlorine and hypochlorous acid so alter fetal and respiratory cells of alveoli and the endothelium of capillaries that not only is circulation of corpuscles interfered with, but respiratory processes of alveolar tissue are retarded or prevented.

(*e*) The alveoli of hepaticized areas contain fluid poor in cellular elements. Frequently much fluid pours into alveolar passages, extending to terminal bronchi and larger subdivisions of the bronchial tree. Usually, however, in these larger air passages the fluid is mixed with air and is frothy. Hence a freshly cut surface of gassed lung, though apparently dry, when gently squeezed is made to froth from the end of air passages. In the living animal the abundance of fluid in these air passages is evidenced by a pronounced râle during respiratory movements.

2. *A comparison of the responses of representatives of different phyla from the protozoa to the mammalia, in gradients of environmental factors with particular reference to their method of reaction:* V. E. Shelford, University of Illinois.

The "general interest" session of Monday afternoon took the form of a symposium on the "Contributions of zoology to human welfare." Papers were read by Dr. L. O. Howard and Professor H. B. Ward. The paper of Dr. Hugh M. Smith, commissioner of fisheries, who was unable to attend the meeting, was read by the secretary. These papers together with one by Professor M. A. Bigelow, who was unable to be present, will appear elsewhere in Science.

The meetings of Tuesday, January 1, were in charge of the officers of The American Society of Naturalists and have been reported in Science by the secretary of that society, Professor Bradley M. Davis.

Herbert V. Neal,
Secretary